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Sky Guide / Tracker 2020/2021

**Graduation Project Documentation**

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**Sky Guide / Tracker**

**A Project Submitted in partial fulfilment of the requirements for the Degree of Bachelor of Science in Systems and Computers Engineering**

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**2020/2021**

Each graduation project is assigned to an examiner committee. The committee has three members nominated by the graduation project committee. The examiner committee has a president, and two more members such that the project supervisor is one of the two members. The name, rule, and signature of each examiner is shown in the following table. The examiners' signatures are required before students can submit their project final report/documentation. Therefore, students are responsible for asking each examiner to sign next to his name in the following table.

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| **Examiner Committee** | | |
| **Name** | **Rule** | **Signature** |
| Prof. | President |  |
| Prof. |  |  |
| Dr. | Supervisor |  |
| Dr. | Member |  |

**ABSTRACT**

For most people, the night sky is a mystery because it’s really difficult to find a certain object in the night sky using the naked eye, however, in reality the night sky is a detailed map;

Just like the coordinates of any place on earth, each celestial object can be located using specific coordinates, our project aims to exploit this fact.

Sky Guide consists of two main parts that enable the user to find and track any object in the sky, these are:

* *Desktop application*:

We’ve established a moderate database, that contains a set of coordinates and information for some of the most famous celestial objects (stars, nebulas, etc); From the desktop application we access this database to retrieve the coordinates of the required object, and send it to the physical device.

* *Physical device:*

The device receives the coordinates of the required object -from the desktop application- and points toward it.

This project is targeting the amateur astronomers and the astrophotography community, and it can be used as a Telescope German Equatorial Go-To Mount.

KEYWORDS: Astronomy; Astrophotography; Telescope Mount;

**ACKNOWLEDGEMENTS**

***"Praise be to Allah, who guided us to this and we would never have been guided if Allah had not guided us."***

We would like to thank Dr. Khaled Al-Shafei for advice, encourage, support and mentoring has offered us during project also in the class.

We would like to thank our friend and colleague Eng. Mostafa Arafa from the department of mechanics, for helping us greatly in the design of the physical device.

Also, we would like to thank staff doctors and Engineers of facility members of the department of systems and computer engineer for their help and encouragement.

Finally, we would like to thank our parents for support and encouragement.

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**GLOSSARY AND LIST OF ABBREVIATIONS**

**CHAPTER 1**

**INTRODUCTION**

## Background and Motivation

The aim of the work described in the Report was to provide a software tool and a device controlled by this software, to find and track any celestial object;

// TO DO

## 1.2 Scientific Idea

Similar to the navigation on earth, where to find a position on earth, a one must know its coordinates -longitude and latitude, there must be a celestial coordinate system to enable us to navigate the sky, this introduces us to the concept of “Celestial sphere” & “Celestial coordinate systems”.

### 1.2.1 Celestial sphere

Celestial Sphere is an abstract sphere that has an infinite radius and shares the same center with the Earth. We imagine that the stars and planets are attached to the inside surface of the celestial sphere.

Standing outside on a clear moonless night far from city lights, it is easy to imagine that one is at the center of such a sphere and that the stars and planets are attached to its inside surface.

Extending the Earth's axis of rotation in both directions onto the celestial sphere determines two points, the north celestial pole and the south celestial pole, similarly, projecting the Earth's equator onto the celestial sphere determines the celestial equator.

As the Earth revolves around the Sun each year, we see the Sun seeming to travel across the celestial sphere. As it does, it traces out an imaginary great circle, which is called the ecliptic.

The plane determined by the Earth's equator is tilted with respect to the plane determined by the ecliptic, so the Sun is north of the equator for 6 months of each year and south of the equator for the other 6 months. The ecliptic and the equator cross at two points, the vernal equinox and the autumnal equinox. The vernal equinox is the point where the Sun crosses the equator on its way north each year, marking the first day of spring in the Northern Hemisphere. See illustration fig (1).

Chart, radar chart

Description automatically generated

Fig 1.1

### 1.2.2 Celestial coordinate systems

There are many celestial coordinate systems, for example:

Horizontal system, Galactic system, Ecliptic system and Equatorial system -which is used in this project.

*Equatorial coordinate system:*

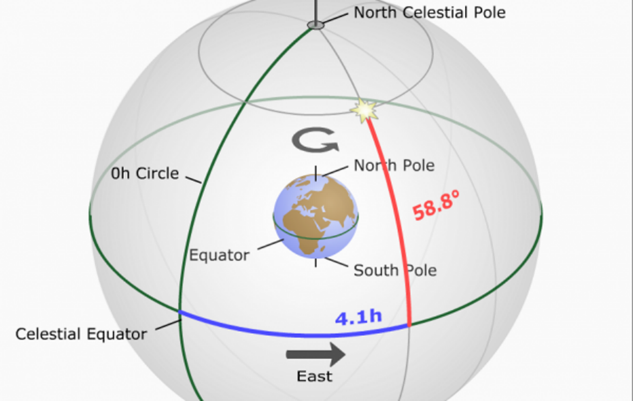
As the distances to the stars and planets are so great, two different observers see the same star in the same direction and thus the star can be thought of as being at a specific “position” on the celestial sphere.

Using the two poles, the equator, and the ecliptic, it is straightforward to establish a coordinate system that makes it possible to determine the position of any object in the sky. The system is similar to the system of latitudes and longitudes used for the locations of objects on the surface of the Earth. Right ascension -abbreviated RA or with the Greek letter α- is analogous to longitude. Declination -abbreviated Dec or with the Greek letter δ- is analogous to latitude.

As with longitude on the Earth, it is necessary to choose a “zero” point for right ascension, we use on earth a meridian -a great semicircle from one pole to the other, perpendicular to the equator- passing through Greenwich, England. On the celestial sphere we use the meridian that passes through the vernal equinox. Every point on this prime meridian has a right ascension of zero.

Right ascension is measured in hours and minutes, ranging from 0 hours, 0 minutes to 23 hours, 59.999… minutes. Hours are used rather than degrees because the entire sphere seems to rotate once per day. Each hour of right ascension corresponds to 15°. Right ascension increases toward the east.

Declinations are measured north and south of the equator with angles between 0° and 90°, measured in degrees and minutes. Northern declinations are considered positive, southern declinations negative.



For example: If a star is located at RA = 4.1h and Dec = 58.8°, the following figure illustrates the position of this star.

Fig 1.2

## 1.3 Problem definition

As the earth revolves around itself a full revolution per day, any celestial object seems to be moving across the sky -from the east towards the west, due to this fact, it’s very difficult to find the exact RA of a particular celestial object, and to track this object across the sky.

So, for a given celestial object, we shall have its coordinates -RA and Dec- and it’s required to find this particular object and track it across the sky.

## 1.4 Survey

There are many companies develop smart mounts in order to solve these problems

Among these companies:

* Celestron:

Celestron is a company that manufactures and distributes telescopes and telescope mount. An example of their telescope mounts, CGX EQUATORIAL MOUNT

In this section, you should describe the problem that you set out to solve with the project. An introduction might, for example, begin by stating, "The aim of the work described in the Report was to provide a software tool with which peoplecan arrange meetings." Avoid starting a Report with an irrelevant history ofinformation technology.

Explain whatever background the reader will need in order to understand the problem. The background might refer to previous work in the academic literature that provides evidence that the problem is a real and significant problem worth solving. Include a clear and detailed statement of the project aims and provide an overview of thestructure of the solution. Please note that the GP2 report (492) should have more literature material than the GP1 (491).

**Leave 8 spaces at the beginning of paragraphs**

**except the first paragraph in each section**

Conventionally, the last part of the introduction outlines the remainder of the Report,explaining what comes in each section. Your report should be organized as follow:

**Start from this page with Arabic numbering**

**CHAPTER 2**

**BACKGROUND MATERIALS**

## Introduction

This chapter introduces the necessary background material related to the underlying project. It is often appropriate to provide more information than was given in your Introduction. Try to limit yourself just to what the reader needs to know to understand the solution that you havedeveloped in your project. Put your work in the context of related existingwork, commercial products, and research papers (if relevant).

## Graph Colouring

## Meta-Heuristic Methods

Sub-Sub title font is time new roman with 12pt and not bold.

A. Local Search Methods

You can extend you numbering by using A and leave tab with 2 spaces “Before text indentation = 0.13"”, then Sub A “A.I” and leave tab with 7 spaces “Before text indentation = 0.44"”, then Sub-Sub A “A.I.1” and leave tab with 15 spaces “Before text indentation = 0.94"”.

A.I Hill Climbing

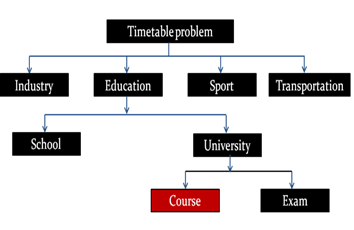
Sub A “A.I” and leave tab with 4 spaces.

B. Population Based Algorithms

B.I Evolutionary Algorithms

B.I.1 Harmony Search Algorithm

Figure can be cited inside the text by using “Figure”, for example, figure 1 shows the classification of the timetable problems.



**Figure: bold with capitalizing the first letter.**

**First number: Chapter number**

**Second number: figure number within the chapter starting from 1 then followed by a colon (:)**

**Figure 2.1:** Timetable scheduling problems classification.

**Figure caption: under the figure.**

**Font: 11pt**

**Style: Time New Roman**

Figure 1 shows that before and after spacing should be equal to 12pt. The figure caption is under the figure. Figures are center justification. If you start a paragraph with the word “Figure” then we use capital F, otherwise small f.

Tables are similar to the figures, but the difference that the table caption is above the table, for example, Table 1 shows the physical annealing converting to simulated annealing. In addition that, the column header are bold.

**Table caption: Above the table.**

**Font: 11pt**

**Style: Time New Roman**

**Table 2.1:** The physical annealing converting to simulated annealing (Cerny, 1985).

|  |  |
| --- | --- |
| **Thermodynamic Simulation** | **Combinatorial Optimization** |
| System States  **Table: bold with capitalizing the first letter.**  **First number: Chapter number**  **Second number: table number within the chapter starting from 1 then followed by a colon (:)** | Feasible Solutions |
| Energy | Cost |
| Change of State | Neighbouring Solutions |
| Temperature | Control Parameter |
| Frozen State | Heuristic Solution |

References are cited inside the text between “(” and ”)”. We Use APA style, see the examples in the references section.

## Methodology

Analysis and Specification: How you analyzed the problem, including user requirements. Give an appropriate specification of the solution. This is done inGP1.For example, we can include, the method used, functional requirements, non-functional requirements, and security requirements.

**CHAPTER 3**

**SYSTEM DESIGN**

## Introduction

Design: if it is a software development project then give a high-level account of the structure of your software and how it works. What algorithms does it use? How do these compare with alternatives? What were the main design decisions you took, and their justifications? This is done in GP1.

Implementation and testing: a detailed account of the implementation and testing of your software. Explain the conceptual structure of the algorithms. Also explain what data structures you used, and how the algorithms were implemented. What implementation decisions did you take, and why? There is no need to list every little function and procedure and explain its working in elaborate detail; use your judgment on what is appropriate to include. This is done in GP2.

**CHAPTER 4**

**RESULTS AND DISCUSSION**

## Results

Results: you should assess the success of your project. How does it compare with the original specification? How reliable is it? How have you tested it? Comment on its robustness. This is done in the final documentation of the project.

## Discussion

Discussion: here you will summarize your achievements and also the deficiencies of your project. You can also say what you would or could have done, if you had had more time or if things had worked out differently. It is important to be completely honest about the deficiencies and inadequacies of your work, such as they are. Part of your aim is to demonstrate your ability to recognize problems that remain. This is done in GP2.

**CHAPTER 5**

**CONCLUSION AND FUTURE WORK**

## Conclusion

Give a brief statement of how the solution that you have provided addresses the problem stated in the introduction. Provide an evaluative statement based on the results. You should not introduce new material.

## Future Work

Future Work: here you will recommend what is needed to be done in the future to your work. This is done in GP2.

**REFERENCES**

Cerny, V. 1985.Thermodynamical Approach to the Traveling Salesman Problem: An Efficient Simulation Algorithm, *J. Opt. Theory Appl.*, volume 45, number1, pages.41-51.

References: for your Final Year project, it is required that you cite and reference work to which you owe an intellectual debt. It is required that you cite and reference work that provides supporting evidence. It is required that you cite and reference work so that the reader can find the sources that have been quoted.

In other words, the purposes of a reference are to acknowledge the contributions of other authors and to enable readers to locate source easily. In this section, you can use alphabetically or numerically system (e.g. APA style referencing).

**General guidelines:**

**APA Reference List Examples**

* **Book with Single Author:**

Gore, A. (2006). *An inconvenient truth: The planetary emergency of global warming and what we can do about it.* Emmaus, PA: Rodale.

**In-text reference:** (Gore, 2006)

* **Book with Two Authors:**

Michaels, P. J., & Balling, R. C., Jr. (2000).*The satanic gases: Clearing the air about global warming*. Washington, DC: Cato Institute.

**In-text reference:** (Michaels & Balling, 2000)

* **Book with Editor as Author:**

Galley. K. E. (Ed.). (2004). *Global climate change and wildlife in North America.*Bethesda, MD: Wildlife Society.

**In-text reference:** (Galley, 2004)

* **An Anonymous Book:**

*Environmental resource handbook*. (2001). Millerton, NY: Grey House.

**In-text reference:** (Environmental Resource Handbook, 2001)

* **Articles in Reference Books (unsigned and signed):**

Greenhouse effect.(2005). *American heritage science dictionary*. Boston, MA: Houghton Mifflin.

Schneider, S. H. (2000). Greenhouse effect.*World book encyclopedia* (Millennium ed. Vol. 8, pp. 382-383). Chicago, IL: World Book.

**In-text references:** (Greenhouse effect, 2005)

(Schneider, 2000)

* **Journal Article when each issue begins with p.1:**

Bogdonoff, S., & Rubin, J. (2007). The regional greenhouse gas initiative: Taking action in Maine. *Environment, 49*(2), 9-16.

**In-text reference:** (Bogdonoff& Rubin, 2007)

* **Website:**

United States Environmental Protection Agency. (2007, May 4). *Climate Change*. Retrieved From the Environmental Protection Agency website: http://www.epa.gov/climatechange

**In-text reference:** (United States Environmental, 2007)

Gelspan, R. (2007). *The Heat Is Online*. Lake Oswego, OR: Green House Network. Retrieved from The Heat Is Online website: http://www.heatisonline.org

In-text reference: (Gelspan, 2007)

**How to Cite an Website in APA**

**Structure:** Last, F. M. (Year, Month Date Published). Article title.*Website Title*.Retrieved Month Date, Year, from URL.

**Example:**

* Satalkar, B. (2010, July 15). Water aerobics. *Buzzle*.com. Retrieved July 16, 2010, from http://www.buzzle.com.
* Cain, K. (2012, June 29). The Negative Effects of Facebook on Communication. *Social Media Today RSS*. Retrieved January 3, 2013, from <http://socialmediatoday.com>.

OR numerically as below

All reference items must be in 10pt font. Please use Regular and Italic styles to distinguish different fields. Number the reference items consecutively in square brackets (e.g. [1]).

When referring to a reference item, please simply use the reference number, as in [2]. Do not use “Ref. [3]” or “Reference [3]” except at the beginning of a sentence, e.g. “Reference [3] shows …”. Multiple references are numbered with one bracket and separated with comas (e.g. [2], [2, 3], [4 – 6]).

Structure: First Author Last Name, First Author First Name.

[1]Author. (Date published if available; n.d.--no date-- if not). Title of article/book. *Title of web site* . Retrieved date. From URL.

[2]Author. (Date published if available; n.d.--no date-- if not). Title of article/book. Title of web site . Retrieved date. From URL.

**APPENDICES**

**Appendix A:**

Appendices: the Report must contain an appendix explaining file structure on thedata CD submitted with it. The appendix must also contain information on how thecode should be run. Other appendices may include documents such as: the projectproposal; a selection of experimental data; schedules; testing strategy; riskmanagement plans; glossary; manual; etc. Don't include the source code as anappendix (submit it on CD; see below). Don't include voluminous appendices (theseshould also be submitted on a CD). A report template can be found in the collegewebsite.

**Timeline/Milestones (Gantt Chart)**

This course is similar to self-study/research. Weekly meetings are scheduled with the supervisor for the project. Each student’s group will meet together weekly, keeping detailed minutes of the meetings.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Task |  | Weeks | | | | | | | |
|  |  | 1-2 | 3-4 | 5-6 | 7-8 | 9-10 | 11-12 | 13-14 | 15 |
|  |  |  |  |  |  |  |  |  |  |
| 1. …….. |  |  |  |  |  |  |  |  |  |
| 2. …….. |  |  |  |  |  |  |  |  |  |
| 3. …….. |  |  |  |  | |  |  |  |  |
| 4. …….. |  |  |  |  |  |  | |  |  |
| 5. …….. |  |  |  |  |  |  |  |  |  |
| ……….. |  |  |  |  |  |  |  |  | |